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FISKERIDIREKTORATETS SKRIFTER
Serie Havundersøkelser
(Reports on Norwegian Fishery and Marine Investigations)
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Some Observations on the Food of Cod *(Gadus callarias L.)* of the 0—II-group from Deep Water and the Littoral Zone in Northern Norway and from Deep Water at Spitzbergen

by
K. F. WIBORG

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A.s John Griegs Boktrykkeri, Bergen

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MATERIAL.

During September and October 1946 samples of cod of the 0—II-group were collected in Northern Norway. They were caught partly on the trawling grounds with a prawn trawl, partly in the littoral zone with a young-fish seine.

On July 16th one sample of cod of the I—II-group was taken in prawn trawl on the trawling ground Rekesøyla at Spitzbergen.

The material was collected for the purpose of studying racial differences between the coastal cod and the arctic cod, but in some localities (fig. 1) investigations were also made of the stomach content.

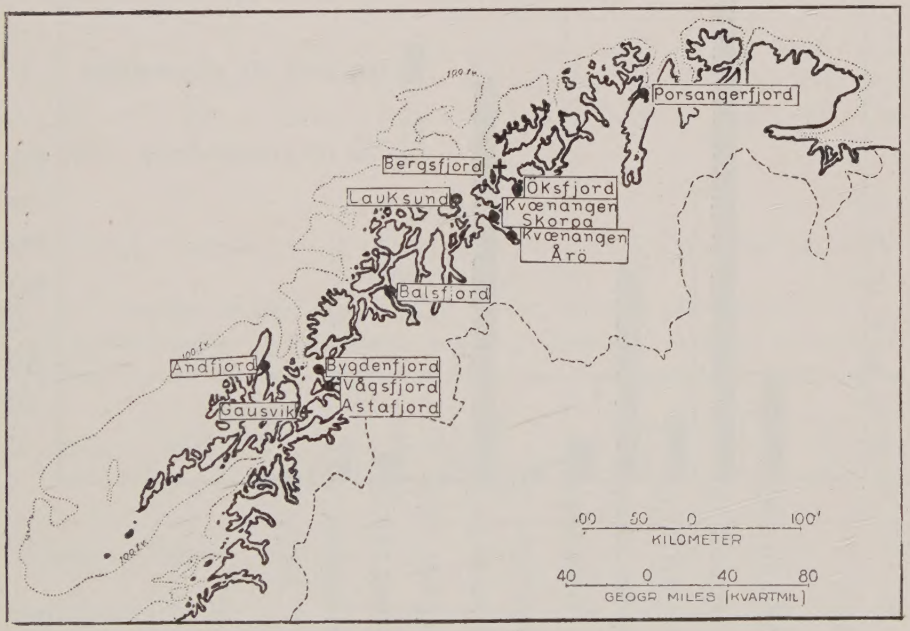

Fig. 1. Localities in Northern Norway where samples of cod of the 0—II-group where taken. September—October 1946.

+ In the littoral zone.

● In deep water.

METHODS.

The material was preserved in 4—10 percent formaline with the addition of some NaCl.

From deep water a total of 167 stomachs of cod of the 0-group and 74 of the I—II-group were examined, and from the littoral zone 66 stomachs of cod of the 0-group were investigated. As many of the cod from the trawling grounds had turned the stomachs inside out when they came out of the water, no attention was paid to the number of empty stomachs, and only such individuals which had stomach contents, were investigated.

For the enumeration of the euphausiids the eyes were counted (Brown and Cheng 1946).

Some of the organisms were so much dissolved that they could not be identified further than to group or family.

A complete list of the food species found in the stomachs of cod of the 0—II-groups is given in table V (page 17).

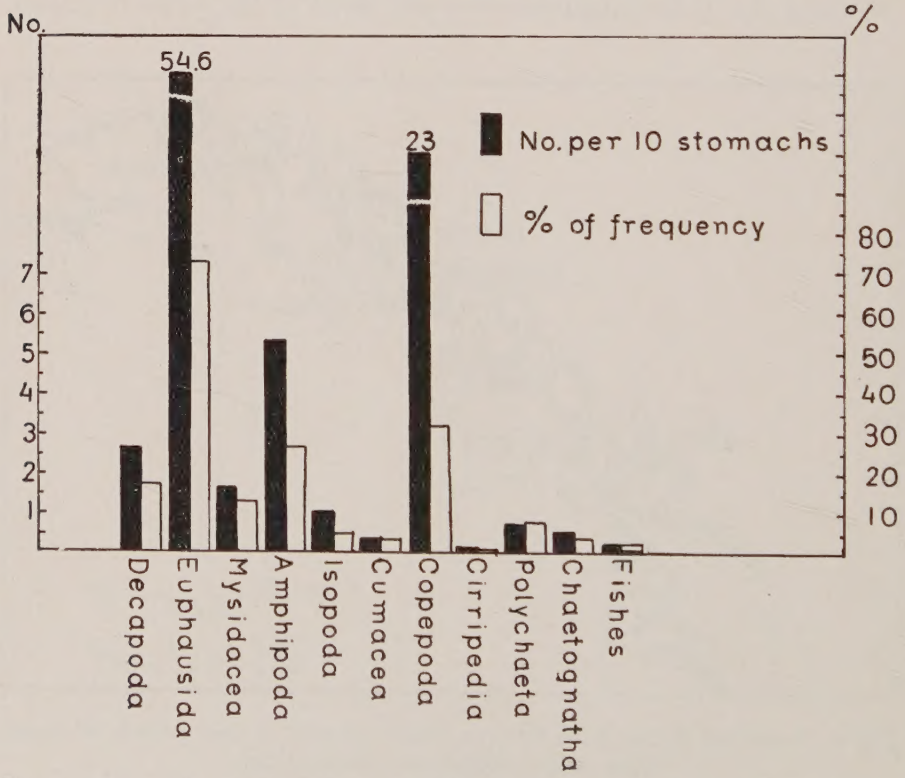

Fig. 2. The food of 148 cod of the 0-group from some trawling grounds in Northern Norway, September—October 1946.

FOOD OF THE 0-GROUP OF COD FROM DEEP WATER.

In fig. 2 is shown the food of cod of the 0-group from some trawling grounds in Northern Norway. (Table I, page 13).

The main content of the stomachs consisted of crustaceans. The euphausiids range first both in number and frequency, the number per stomach being about 5, and they occur in 73 % of the stomachs investigated. *Thysanoessa inermis* is most often met with.

The copepods range second in number and frequency. Owing to their small size, however, they are of less importance than the following groups.

The amphipods are next in numerical importance. There are several species, but *Halirages fulvocinctus* and *Rachotropis helleri* are most common.

Of the decapods *Pandalus borealis* is the most important species, of the mysids *Erythrops erythrophtalma* and *Michteimysis mixta*.

The remaining groups of food organisms are of minor importance.

FOOD OF THE I—II-GROUP OF COD FROM DEEP WATER.

The cod of the I—II-group from deep water has about the same diet as that of the 0-group, with the euphausiids as the main food, but other crustaceans, especially amphipods, isopods, decapods and mysids now play a greater part (fig. 3, and table II, page 14). The copepods are scarce.

TABLE 1.

The stomach content of cod of the I—II-group from a trawling ground at Spitzbergen, July 1946.

Number of food organisms in all the stomachs investigated.

In ( ) the number of stomachs in which the different organisms are found.

Locality	Date	Number of cod	Length, mm	Decapoda	Euphausida	Mysidacea	Amphipoda	Isopoda	Cumacea	Copepoda	Polychaeta	Pisces	Mollusca
Rekesøyla	16/7	30	130—175	3	1	6	362	1	3	1	8	4	+[1]
Spitzbergen				(3)	(1)	(4)	(30)	(1)	(3)	(1)	(7)	(4)	(4)
Number of organisms per 10 stomachs				1	0.3	2	120.7	0.3	1	0.3	2.7	1.3	+
Percentage of frequency				10	3	13	100	3	10	3	23	13	13

[1] 1 pycnogonid.

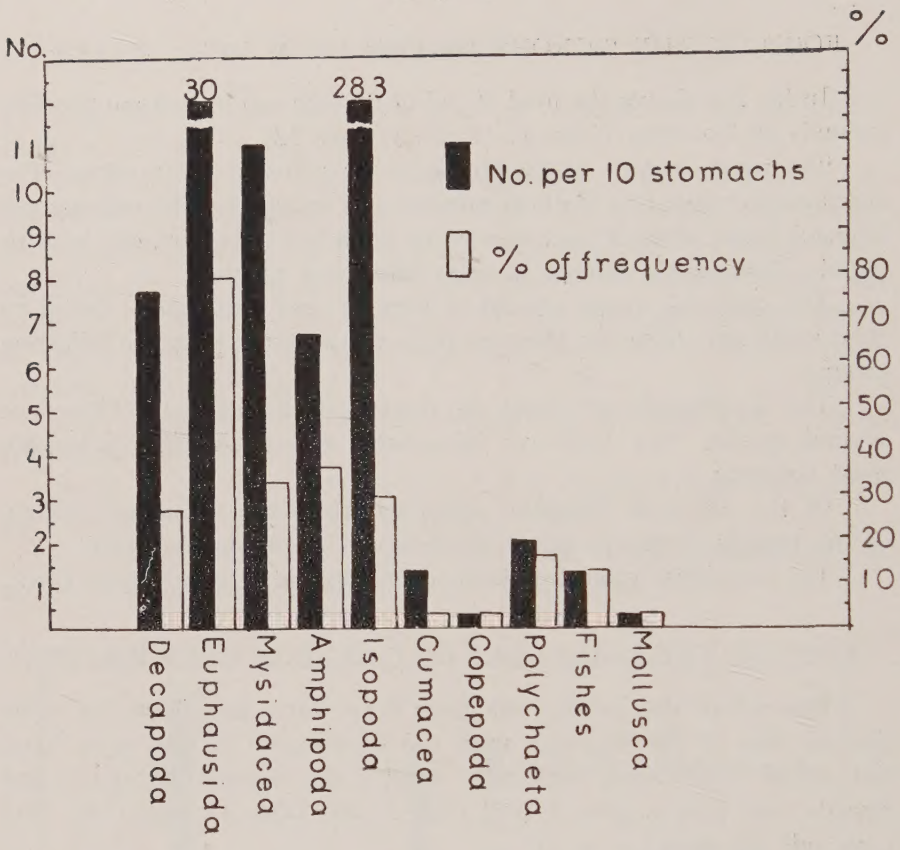

Fig. 3. The food of 30 cod of the I—II-group from some trawling grounds in Northern Norway. September 1946.

At Spitzbergen (table 1) the cod of the I-group feeds most exclusively on amphipods which are found in great numbers in all the stomachs examined, averagely 12 per stomach. The dominant species is *Euthemisto libellula*. The other groups of food organisms have all about the same percentage of frequency, except the euphausiids and copepods, which are scarce.

In Lauksund some cod of the 0—I-group were caught with a prawn trawl at a depth of 50 m, on a bottom with gravel and sand. As one would expect this cod had a diet different from those living on the trawling grounds, where the bottom consisted of mud.

Fig. 4 shows the composition of the stomach contents. The cod of the 0-group feeds mostly on copepods and decapods (see table III, page 15). The copepods are nearly all harpacticids, mainly *Idyaea furcata* which occurs in great number, averagely 100 specimens per

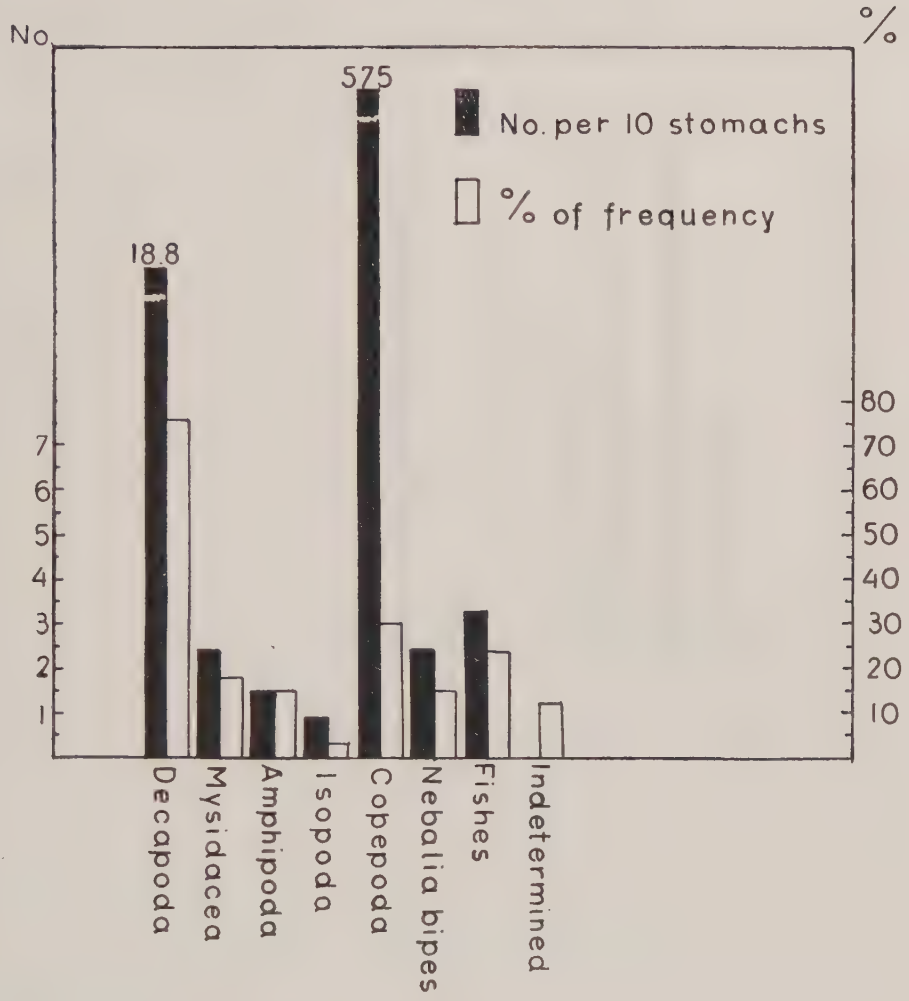

Fig. 4. The food of 33 cod of the 0—I-group from Lauksund, Northern Norway. Depth 50 m, bottom gravel and sand. September 23rd 1946.

stomach. Of the decapods *Pandalus montagui* and *P. propinquus* are the most common species.

The cod of the I-group seems to prefer somewhat larger food organisms. The copepods are lacking in the stomach contents. The decapods play the greatest part, but other groups of crustaceans are also represented. Fishes are more common than in the stomachs of cod of the 0-group.

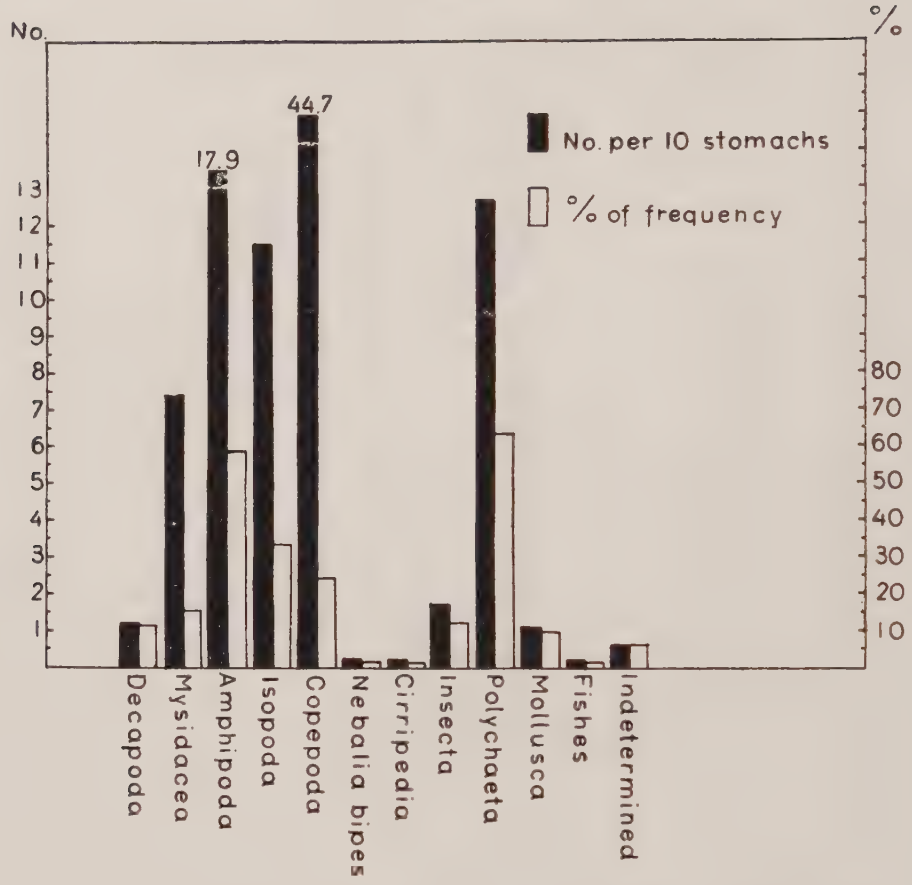

Fig. 5 The food of 66 cod of the 0-group from the littoral zone in Gausvik and Bergsfjord, Northern Norway. September 1946.

FOOD OF COD OF THE 0-GROUP IN THE LITTORAL ZONE

In shallow water the food of cod of the 0-group naturally differs from that of the cod in deep water. In fig. 5 is shown the composition of the food of some cod of the 0-group from the littoral zone in Gausvik and Bergsfjord (see also table IV, page 16).

Numerically the copepods range first. Both pelagic and bottom-dwelling species are found in the stomachs, but the harpacticids are most common, especially *Harpacticus uniremis*.

The polychaetes are not so numerous, but nevertheless frequently met with. They were difficult to identify, but some of them probably belonged to the genus *Lepidonotus*.

The amphipods range second in number and frequency. There were

different species which were only partly identified. *Gammarus* sp. seems to be most common.

Isopods were also present in the stomach contents.

Together with the polychaetes the crustaceans form the main food of the cod of the 0-group in the littoral zone.

DISCUSSION.

The material of cod of the 0—II-group is sampled in the course of 2 months and therefore naturally of restricted value for a general investigation of the food organisms. The number of stomachs examined is also so small that general conclusions cannot be drawn.

Nevertheless there some is main features which must be paid attention to. Different groups of crustaceans form the main part of the food of cod of the 0—II-group both in shallow and deep water. On the trawling grounds the euphausiids, especially *Thysanoessa inermis*, are of special importance as food. Brown and Cheng (1946) point to the fact that around Bear Island large cod feed mainly on this species during the summer months.

The same autors also mention that *Euthemisto libellula* in August 1930 formed the principal food of the cod on the Bear Island grounds. It will be remembered that the cod of the I-group caught at Spitzbergen on July 16th, 1946, had mainly eaten *Euthemisto libellula*.

Since the euphausiids form an important part of the food of the cod, they are probably not entirely planctonic, but must in periods keep to the water layers near the bottom. One might also assume that the cod at intervals leave the bottom and search for food in the water layers some distance above the bottom.

REFERENCE.

BROWN, W. W. and C. CHENG 1946. Investigations into the food of the cod (*Gadus callarias* L.) off Bear Island and of the cod and haddock (*G. aegle-finus* L.) off Iceland and the Murman coast. Hulls Bulletins of Marine Ecology, Vol. III, No. 18. Hull.

TABLE I.

The stomach content of cod of the 0-group from some trawling grounds in Northern Norway, September—October 1946. Number of food organisms in all stomachs investigated. In ( ) the number of stomachs in which the different organisms are found.

Locality	Date	No. of cod	Length, mm	Decapoda	Euphausida	Mysidacea	Amphipoda	Isopoda	Cumacea	Copepoda	Cirripedia	Polychaeta	Chaetognatha	Pisces
Vågsfjord—Astafjord	14/9	29	69—116	21	73	1	30	—	—	1	—	1	—	—
				(12)	(16)	(1)	(16)	—	—	(1)	—	(1)	—	—
Bygdenfjord.....	16/9	26	65—107	11	16	7	36	15	1	217	—	10	—	2
				(7)	(9)	(6)	(12)	(7)	(1)	(16)	—	(10)	—	(2)
Kvænangen, Åro	24/9	21	57—98	—	355	2	3	—	3	92	—	—	2	—
				—	(20)	(2)	(3)	—	(3)	(11)	—	—	(2)	—
Kvænangen, Skorpa	24/9	24	71—105	1	65	5	4	—	1	10	—	—	—	1
				(1)	(20)	(4)	(3)	—	(1)	(6)	—	—	—	(1)
Øksfjord, Kalhovde	17/10	6	72—100	—	5	—	3	—	—	1	1	—	5	—
				—	(4)	—	(3)	—	—	(1)	(1)	—	(3)	—
Porsangerfjord.....	4/10	19	68—118	5	31	6	1	—	—	3	—	—	—	—
				(5)	(16)	(4)	(1)	—	—	(3)	—	—	—	—
Andfjord, Eldaflesa	14/10	23	58—110	—	264	2	2	—	—	16	2	—	—	—
				—	(23)	(2)	(1)	—	—	(9)	(1)	—	—	—
Total.....		148		38	809	23	79	15	5	340	3	11	7	3
				(25)	(108)	(19)	(39)	(7)	(5)	(47)	(2)	(11)	(5)	(3)
Number of organisms per 10 stomachs				2.6	54.6	11.6	25.3	1.0	0.3	23	0.2	0.7	0.5	0.2
Percentage of frequency ..				16.9	73.0	12.8	26.4	4.7	3.4	31.8	1.4	7.4	3.4	2.0

TABLE II.

The stomach content of cod of the I -II-group from some trawling grounds in Northern Norway, September 1946.
Number of food organisms in all stomachs investigated.
In ( ) the number of stomachs in which the different organisms are found.

Locality	Date	No. of cod	Length, mm	Decapoda	Euphausida	Mysidacea	Amphipoda	Isopoda	Cumacea	Copepoda	Polychaeta	Pisces	Mollusca
Kvænangen, Skorpa	25/9	8	142—204	18	44	4	34	—	4	1	—	1	—
				(5)	(7)	(1)	(3)	—	(1)	(1)	—	(1)	—
Balsfjord	17/9	13	143—181	—	24	6	10	19	—	—	—	1	—
				—	(10)	(3)	(4)	(3)	—	—	—	(1)	—
Balsfjord	»	9	228—260	5	22	23	6	66	—	—	6	2	1
				(3)	(7)	(6)	(4)	(6)	—	—	(5)	(2)	(1)
Total		30		23	90	33	50	85	4	1	6	4	1
				(8)	(24)	(10)	(11)	(9)	(1)	(1)	(5)	(4)	(1)
Number of organisms per 10 stomachs				7.7	30	11	6.7	28.3	1.3	0.3	2	1.3	0.3
Percentage of frequency				27	80	33.3	36.7	30	3.3	3.3	16.7	13.3	3.3

TABLE III.

The stomach content of cod of the 0—I-group from Lauksund, Northern Norway, September 23. 1946.
Depth 50 m, bottom gravel and sand.

Number of food organisms in all stomachs investigated.

In ( ) the number of stomachs in which the different organisms are found.

No. of cod	Length, mm	Decapoda	Mysidacea	Amphipoda	Isopoda	Copepoda	*Nebalia bipes*	Pisces	Indetermined
19	68—110	26	6	3	3	1900	5	6	+
		(14)	(4)	(3)	(1)	(10)	(2)	(3)	(3)
14	130—248	36	2	2	—	—	3	5	+
		(11)	(2)	(2)	—	—	(3)	(5)	(1)
33		62	8	5	3	1900	8	11	+
		(25)	(6)	(5)	(1)	(10)	(5)	(8)	(4)
Number of organisms per 10 stomachs		18.8	2.4	1.5	0.9	575 (1000)[1]	2.4	3.3	—
Percentage of frequency ..		76	18	15	3	30 (53)[1]	15	24	12

[1] 0-group only.

TABLE IV.

The stomach content of cod of the 0-group caught in the littoral zone in Northern Norway September—October 1946.

Number of food organisms in all stomachs investigated.

In ( ) the number of stomachs in which the different organisms are found.

Locality	Date	No. of cod	Length, mm	Decapoda	Mysidacea	Amphipoda	Isopoda	Copepoda	*Nebalia bipes*	Cirripedia	Insecta	Polychaeta	Mollusca	Pisces	Indetermined
Gausvik	14/9	31	51—110	7	49	62	42	257	—	—	10	15	+	1	2
				(7)	(10)	(17)	(8)	(10)	—	—	(7)	(10)	(2)	(1)	(2)
Bergsfjord	28/9	35	59—106	1	—	56	34	38	1	1	1	69	7	1	2
				(1)	—	(22)	(14)	(6)	(1)	(1)	(1)	(32)	(4)	(1)	(2)
Total		66		8	49	118	76	295	1	1	11	84	7	2	4
				(8)	(10)	(39)	(22)	(16)	(1)	(1)	(8)	(42)	(6)	(2)	(4)
Percentage of frequency				1.2	7.4	17.9	11.5	44.7	0.2	0.2	1.7	12.7	1.1	0.4	0.6
Number of organisms per 10 stomachs				11.9	15.1	59.0	33.3	24.3	1.5	1.5	12.1	63.5	9.2	3.0	6.1

TABLE V.

The food of cod of the 0—II-group from the littoral zone (Gausvik and Bergsfjord) and from trawling grounds in Northern Norway and Spitsbergen in the autumn of 1946.

	Gausvik	Bergsfjord	Andfjord	Vågsfjord-Astafjord	Bygdenfj.	Balsfjord	Lauksund	Kvænangen Skorpa	Kvænangen Arø	Øksfjord	Porsangerfj.	Spitzbergen
MEDUSAE:												
Medusae remains	—	—	—	—	—	—	×	—	—	—	—	×
CHAETOGNATHA:												
Sagitta sp.	—		—	—	—	—	—	—	×	×	—	—
MOLLUSCA	—	×	—	—	—	—	×	—	—	—	—	—
POLYCHAETA:												
Lepidonotus sp. and others	×	×	—	—	×	×	—	—	—	—	—	×
Tomopteris sp.	—	—	—	—	—	×	—	—	—	—	—	—
NEMERTINI	×	—	—	—	—	—	—	—	—	—	—	—
INSECTA indet.	×	×	—	—	—	—	—	—	—	—	—	—
COPEPODA:												
Calanus finmarchicus (Gunn.)	—	—	×	—	—	—	—	×	×	—	×	—
? Chividius armatus (Boeck)	—	—	×	—	—	—	—	×	×	—	—	—
Bryaxis brevicornis Boeck	—	—	—	—	×	—	—	—	—	—	—	—
Undinopsis bradyi G. O. Sars	—	—	—	—	×	—	—	—	—	—	—	—
Undinopsis similis G. O. Sars	—	—	—	—	—	—	—	—	—	—	×	×
Stephos sp.	—	—	—	—	—	—	—	—	×	—	—	—
Centropages hamatus (Lilljeborg)	—	×	—	—	—	—	—	—	—	—	—	—
Temora longicornis (Müller)	—	×	—	—	—	—	—	—	—	—	—	—
Candacia sp.	—	—	—	—	—	—	×	—	—	—	—	—
Acartia clausi Giesbrecht	—	×	—	—	—	—	—	—	—	—	—	—
Oithona helgolandica Claus	—	×	—	—	—	—	—	—	—	—	—	—
Hermanella sp.	—	—	—	—	×	—	—	—	—	—	—	—
Ectinosoma sp.	—	×	—	—	—	—	—	—	—	—	—	—
Harpacticus uniremis Krøyer	—	×	—	—	—	—	—	—	—	—	—	—
Idyaea furcata Baird	—	—	—	—	—	—	×	—	—	—	—	—
Copepoda indet.	×	—	—	—	—	—	—	×	—	—	—	—
CUMACEA indet.	—	—	—	—	—	—	—	×	×	—	—	×

Table 5 (cont.)

	Gausvik	Bergsfjord	Andfjord	Vågsfjord-Astafjord	Bygdenfj.	Balsfjord	Lauksund	Kvænangen Skorpa	Kvænangen Årø	Øksfjord	Porsangerfj.	Spitzbergen
ANOMURA:												
Eupagurus sp.	×	—	—	—	—	—	×	—	—	—	—	—
Galathea sp. postlarva	—	—	—	—	—	—	—	—	—	—	×	—
LEPTOSTRACA:												
Nebalia bipes	—	×	—	—	—	—	×	—	—	—	—	—
MYSIDACEA:												
Erythrops abyssorum G. O. Sars	—	—	—	—	—	×	—	×	—	—	—	—
Erythrops erythrophtalma (Goës)	—	—	×	—	×	—	×	—	—	—	×	—
Erythrops sp.	—	—	—	—	—	—	—	×	—	—	—	×
Michteimysis mixta (Lilljeborg)	—	—	—	—	—	×	×	—	×	—	—	—
Stilomysis grandis (Goës)	—	—	—	—	—	×	—	—	—	—	—	—
Pseudomma truncatum (S. J. Smith)	—	—	—	—	—	—	—	×	—	—	—	×
Praunus inermis (Rathke)	×	—	—	—	—	—	—	—	—	—	—	—
Praunus flexuosus (Müller)	—	×	—	—	—	—	—	—	—	—	—	—
Mysidacea indet.	—	—	×	—	×	—	—	×	—	—	—	—
EUPHAUSIACEA:												
Meganyctiphanes norvegica M. Sars	—	—	×	×	—	—	—	×	—	—	×	—
Thysanoessa inermis (Kröyer)	—	—	×	—	×	×	—	—	×	×	—	×
Nematobrachion boopis (Calman)	—	—	×	—	—	—	—	—	—	—	—	—
? Rhoda raschi (M. Sars)	—	—	—	—	—	—	—	—	×	—	—	—
DECAPODA:												
Pandalus borealis Kröyer	—	—	—	×	×	×	—	×	—	—	—	×
Pandalus montagui (Leach)	×	—	—	—	—	—	×	—	—	—	—	—
Pandalus propinquus G. O. Sars	×	—	—	—	—	—	×	—	—	—	—	—
Leander serratus (Pennant)	×	—	—	—	—	—	—	×	—	—	—	—
Spirontocaris sp.	—	—	—	—	—	—	—	×	—	—	—	—
Sabinea septemcarinata (Sab.)	—	—	—	×	—	—	—	—	—	—	—	—
AMPHIPODA:												
Themisto abyssorum Boeck	—	—	—	×	—	—	—	—	—	—	—	—
Euthemisto libellula (Mandt)	—	—	—	×	—	—	—	—	—	—	—	×
? Hyperia galba (Mont)	—	—	—	—	—	—	—	×	—	—	—	—
Hippomedon propinquus G. O. Sars	—	—	—	—	×	—	—	—	—	—	—	—
? Periculodes sp.	—	—	—	—	—	—	—	—	×	—	—	—
Phoxocephalus holbølli (Kröyer)	—	—	—	—	×	—	—	—	—	—	—	—
Halirages fulvocinctus (M. Sars)	—	—	—	—	—	×	×	×	—	—	×	—
Apherusa bispinosa (Spence Bate)	—	—	—	×	—	—	—	—	—	—	—	—
? Apherusa glacialis (H. J. Hansen)	—	—	—	—	—	—	—	—	—	—	—	×

Table 5 (cont.)

	Gausvik	Bergsfjord	Andfjord	Vågsfjord-Åstafjord	Bygdenfj.	Balsfjord	Lauksund	Kvænangen Skorpa	Kvænangen Årø	Øksfjord	Porsangerfj.	Spitzbergen
Rachotropis helleri (Boeck)	—	—	—	×	—	×	—	×	—	—	—	×
Gammarus sp.	×	—	—	—	—	—	—	—	—	—	—	—
? Jassa sp.	—	×	—	—	—	—	—	—	—	—	—	—
Corophium sp.	—	×	—	—	—	—	—	—	—	—	—	—
Chelura sp.	—	—	—	—	×	—	—	—	—	—	—	—
Podoceridae	—	—	—	—	×	—	—	—	—	—	—	—
Caprellidae	×	×	—	—	×	—	—	—	—	—	—	—
Amphipoda indet.	—	×	—	—	—	—	×	—	—	—	—	—
ISOPODA:												
? Limnoria sp.	×	—	—	—	—	—	—	—	—	—	—	—
? Leptognathia sp.	—	—	—	—	×	—	—	—	—	—	—	—
Gnathia oxyurea (Lilljeborg)	—	—	—	—	×	—	—	—	—	—	—	—
Munnopsis typica M. Sars	—	—	—	—	—	×	—	—	—	—	—	—
Jaera albifrons Leach	×	×	—	—	—	—	—	—	—	—	—	—
? Janira sp.	×	—	—	—	—	—	—	—	—	—	—	—
Cryptoniscidae	—	—	—	—	—	—	×	—	—	—	—	—
Tanaidae	—	—	—	—	×	—	—	—	—	—	—	—
Isopoda indet.	×	×	—	—	—	—	—	—	—	—	—	—
PYCNOGONIDA	—	—	—	—	—	—	—	—	—	—	—	×
CIRRIPEDIA:												
Balanus nauplius	—	×	—	—	—	—	—	—	—	—	—	—
Balanus cypris	—	—	×	—	—	—	—	—	—	—	—	—
PISCES:												
Cottus sp.	—	—	—	—	—	×	—	—	—	—	—	—
Lumpenus sp.	—	—	—	—	—	×	—	—	—	—	—	—
Gadus callarias L.	—	×	—	—	—	—	×	—	—	—	—	—
Hippoglossoides platessoides Fabr.	—	—	—	—	—	—	×	—	—	—	—	—
? Gobius sp.	×	—	—	—	—	—	—	—	—	—	—	—
Pisces indet.	—	—	—	—	—	×	×	—	—	—	—	—